JPRS 79092

29 September 1981

East Europe Report

SCIENTIFIC AFFAIRS

No. 717

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BULGARIA

RESEARCH IN VARIOUS FIELDS OF BIOLOGY, ASSOCIATED AREAS, OUTLINED

Successes in Reproduction Biology

Sofia VECHERNI NOVINI in Bulgarian 1 Aug 81 p 4

[Article by Academician Kiril Bratanov, director of the Unified Biology Center of the BAN [Bulgarian Academy of Sciences]]

[Text] The 12th party congress faced Bulgarian biology with particularly important assignments. The special part of the report submitted by Comrade Todor Zhivkov, entitled "For a Systematic Implementation of the Party's Program for the Development of Science and Education" as well as the theses on the development of our economy in the Eighth Five- Year Plan set several important assignments to the science of biology. These assignments particularly apply to reproduction biology which studies the complex process of animal and human reproduction.

Modern research in this area made it possible to penetrate profoundly into animate nature on the molecular level and the level of molecular complexes, and to study the three basic regulators of processes in animate matter, the three systems--the nervous, hormonal and immunal and the effect of biologically active agents such as enzyme systems, prostaglandins, vitamins and other biological stimulators. This made it possible to study the processes of the reproduction, growth, development, metabolism, immunogenesis, reactions, productivity and others or, generally speaking, processes through which life is manifested in its great variety.

It is in this area that for more than 20 years the Institute of Biology and Immunology of the Reproduction and Development of Organisms has provided a number of works on the interpretation and guidance of the reproduction process. The main task now is to systematize the results of these studies and to convert them into technologies which will direct, control and intensify this process for the benefit of man. A proper recommendation was contained in the theses of the party congress on the extensive use of biogenic stimulators in agriculture. Hence the task of the institute's collective to study even more extensively the effect and effectiveness of the hypophysis, the gonadotropic and lactatropic hormones, the ovarian hormones of the folliculine and protein groups, the placentar gonadotropic hormone, the disticular hormones, the prostaglandins, the hormones in the colastrum and many other natural biological substances which influence both the control of the reproduction process as well as the lactation, growth and development of the organism.

The development of a method for controlling immune processes in man and animals and the study of reproduction immunology is a major achievement of the institute.

Its purpose is to determine the mechanisms of immunosuppression and immunostimulation in connection with the developed methods for fighting the various forms of immunologically caused sterility and abortions and the development of methods and technologies for immunological sterilization.

For more than 30 years the institute has been yielding valuable developments in the area of reproduction immunology and has justifiably earned a leading position in global immunology studies. It is the seat of the International Committee on Reproduction Immunology and the organizer of the so-called "Varna Symposiums" on immunology. The Eighth Five-Year Plan includes the national coordination program "Control of Immune Processes in Animal and Human Organisms." This program coordinates and comprehensively combines all scientific units within the system of the Unified Biology Center of the BAN and the Medical Academy.

An important task based on the decisions of the 12th party congress, related to the biosynthesis of protein, is increasing meat production through the intensification of the reproduction process of sheep, cows, hogs and fish. The congress resolutions call for increasing the number of sheep and cows and for the full utilization of vegetal protein in the huge mountainous and semimountainous pastures. Unquestionably, this requires the even more extensive application of methods for the intensification of the reproduction process in sheep and cattle breeding.

The technologies under development for the impregnation of sheep at an earlier and later age, multiple births and impregnation of aborted sheep have been resolved from the scientific-methodical viewpoint. The difficulties in their application are mainly of organizational-administrative nature. Such difficulties must be eliminated. Currently, every year we are obtaining an additional 75,000 to 80,000 lambs or about 2.4 million kilograms of lamb even though far greater possibilities exist such as, for example, the additional impregnation each year of 600,000 older sheep. This is a major biological researve which must be used. The use of technology for creating twin births in cows, particularly in beef cattle, is a very important task.

Successful studies are being conducted for the transplanting of zygotes and ovarian cells. Offspring has been produced as a result of the transplanting of sheep zygotes kept frozen for 10 months and fresh cow zygotes. This method offers great opportunities for the full utilization of genetically valuable livestock.

Another important success achieved by the institute's collective is the development of methods for causing lactation in sterile cows and sheep. With about 20 percent sterility, every year the country has about 100,000 cows which yield no milk and are economically unprofitable to the cooperative farms. Lactation in such cows is restored through the technology developed by the institute.

Experimental studies of 560 cows in Silistra, Razgrad, Tolbukhin, Turnovo and other okrugs proved the great biological and economic effectiveness of this method. Cow lactation is being restored and, on the basis of genetic factors, 20 to 25 liters of milk per cow have been achieved. At the APK [Agroindustrial Complex] in Razgrad, the cow Oma yields 35 liters of milk daily.

In Silistra Okrug alone, as a result of the application of this method, an additional 600,000 liters of milk will be produced; on the scale of the entire country, several dozen millions of liters will be produced. We anticipate that by the end of this year 10,000 cows will be treated with our method.

A very important task based on the decisions of the party congress is the development of a technology for the freezing of ram sperm in such a way as to lead to a new organization of artificial insemination in sheep breeding, which would save several million leva. The institute has a big collective of more than 30 scientific workers from several scientific workers from several scientific units within the system of the Bulgarian Academy of Sciences successfully working on this problem. We are increasingly expanding the use of the hormonal method for the one-time egg-laying in carps. This year the use of this method will yield more than 15 million young carps. However, the biological potential is far bigger.

The application of the successes achieved in the field of reproduction biolgoy is an indicative example of how biology must serve life and the people.

Docent Dano Danov and Engineer Dimitur Popov at work with an electron microscope.

Activities of Molecular Biology Institute

Sofia TRUD in Bulgarian 3 Aug 81 pp 1-2

[Interview with Academician Rumen Tsanev, director of the Molecular Biology Institute of the BAN, conducted by Tanya Kondakova]

[Text] Many changes have taken place not only in the structure and content of science but in its sociopsychological aspect as well since the already distant times when science in our country stopped being the hobby of individual "elect" people and became a mass, a socially necessary profession. It is as though this lofty realm of spiritual activities dropped from inaccessible heights, with its vague hopes for a better future, and began to be assigned quite immediate tasks based on current needs. That is perhaps the reason why the term "scientific worker" became so widespread. Something seemingly paradoxical resulted: the increased role of the scientific worker in society made the role of the individual in science almost unnoticeable!

Could this be the reason for which because of the fast growth of the forest we are no longer able to see the individual trees clearly, and for looking more at accomplishments than at their authors and more at the objectives and results than at the approach and the road to them--the blend of criteria, assessments, requirements and inner motivations which constitute the so-called value orientation of the scientific personality. For this reason, let us walk in the opposite direction, from the human component in science to its specific accomplishments.

From the journalistic viewpoint Academician Rumen Tsanev cannot be considered an "easy" scientist (if such exist at all!). However, this makes communicating with him the more rewarding.

[Question] Academician Tsanev, I suggest that we begin with a question of a psychological nature. Do you share the concept that "great ideas are born of a great feeling rather than a great mind," or, in other words, that in the creative process the scientist relies more on his intuition and imagination?

[Answer] Yes, but intuition is nothing but subconscious experience which comes to the trained minds only. In addition to knowledge, however, one needs talent in order to achieve the very necessary subconscious connections which will lead to an original idea or solution. I have always claimed, on the basis of my own experience, that it is an absolutely necessary prerequisite for the scientist to have a scientific imagination, to be able to envision undiscovered and previously unseen things and phenomena. The formulation of new hypotheses is sometimes risky also because of the reaction of those around us. I have occasionally cited the example of Niels Bohr who, when asked about the success of his school of thought, answered: "We were not afraid to look silly."

Therefore, yes to imagination. However, this is not a self-seeking consideration which borders on ignorance....

[Question] The increased social role of science moved the front end of the battle for new knowledge to the research collective. Actually, what does the collective method of work mean? Does it always enable the individual to express himself most fully or, nevertheless, is it necessary to give preference to the "mind which thinks alone?"

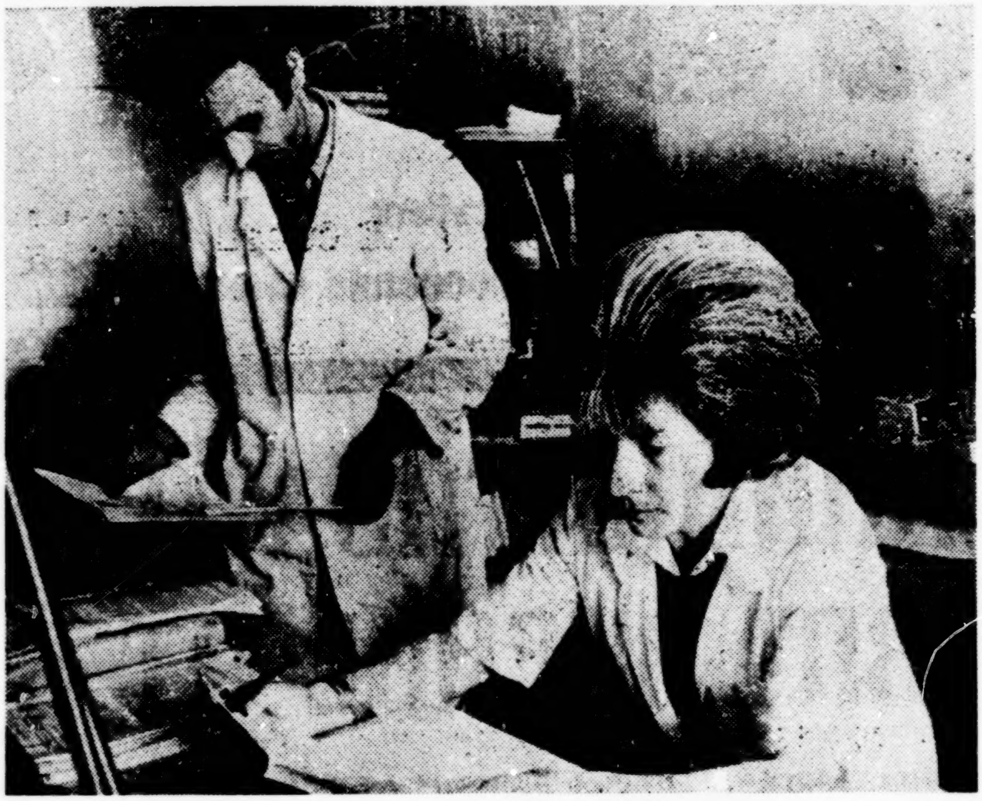
[Answer] Bearing in mind the rapid development of contemporary science, when a great deal of time is required to keep up with extensive publications and to engage in extensive experimentation with the comprehensive interpretation of results it is virtually impossible for a person to work alone, it is simply not within his power. Before undertaking an experiment, for example, we must begin by formulating the problem accurately. We must then develop the blueprint which will be followed in its solution and the specific technical method. In the course of this process every member of the collective can and must participate either by suggesting a good formulation of the question or a specific original solution, a valuable correction or display of experimental skill.

No, the collective method does not hinder the display of individual creativity! It is true that a certain equalization is obtained and the individual contribution may not be always identified on a percentage basis. It is also true that the weak specialist may develop along the more capable ones. In the final account, however, the leading figure becomes eventually identified and earns a reputation by adamantly pursuing and resolving a given problem.

As to thinking, scientific thinking, it always seems to me that rather little time is being assigned for this, for objective and subjective reasons. Whenever I see a scientific worker who keeps working on and on I feel like asking him, as Rutherford used to: "When do you find time to think?..."

[Question] Being engaged in the performance of two functions--scientific research and organization--what do you think: are some employee criteria suitable to the work of the scientific worker? What is it that "erodes" his time budget?

[Answer] I shall answer you by citing the results of an investigation conducted by the International Federation of Scientists. "How long can a scientific worker be productive?" was the question. The answer was the following: "Until he becomes an administrator." Administrative work, fruitless meetings, which are quite abundant with us, a great deal of paper shuffling and bureaucracy are the most terrible enemies of scientific creativity. Add to this the time regulation of the length of the day and the work--which are absolutely unsuitable in this case--the picture becomes clear. Yet these are stipulations designed by people. Therefore, in our effort to fight them we are actually fighting people.



The collective method does not hinder individual creativity. The photograph shows biologist Emiliya Khristova and Lyuben Marekov, a chemist at the Molecular Cytology, working jointly on an institute's project.

Bureaucracy has found its way even in material procurements, something which affects research directly. Any delay in supplies (or simply their unavailability) or the servicing of scientific equipment entails not only unpleasant consequences and distracts our attention but lets us fall behind global developments in this area!

[Question] What is your view on the possibility of planning extensive new developments in basic science? Is this not one of the means for avoiding work on petty topics and waste and for stimulating creative activeness?

[Answer] Who says that science cannot be planned? It is only discoveries that cannot be planned, as to scientific projects, naturally, with determined objectives and effectiveness, must be mandatorily coordinated on a planned basis and financed, thus mobilizing the creative potential of a given collective. At this point the role of the manager and his ability to choose and insist on a topic, in accordance with the important and interesting suggestions of his colleagues, and to surround himself by good cadres, by critical minds, comes to the foreground. Sometimes the reason for poor work should not be hastily sought in poor organization, before the suitability of the cadres concerning a specific task has been determined.

[Question] In a field such as yours, which is new, significant and puzzling, unquestionably "noble curiosity" is the primary, the guiding reason. However, in our time social practice as well expects results from pure knowledge. Is there, nevertheless, still a place for antagonism between it and, let us say, the academic career of a young scientist?

[Answer] The following statements by Louis Pasteur are inscribed on the Palace of Discoveries in Paris: "There is no basic or applied science. There is only science and its application in practice." I too consider such a division entirely wrong. Every scientific worker today is motivated, in addition to his desire to unravel the secrets of nature (or at least should be motivated), by the desire to accomplish something useful to others. However, where is the perfect mechanism which will enable the scientist to participate in applied work, and which will force the interested departments to engage in the application of results? I have the feeling that sometimes, in order to see one's development implemented, one should involve as his co-author the person on whom this depends. This circumstance forces many scientific workers to prefer conventional work to the headaches of promoting application....

[Question] Marx expressed the thought that all suspicion and all baseness must be left at the door of science. In your view, what should be the leading, the determining feature in the moral behavior of the scientist?

[Answer] The cult of scientific truth! This calls for honesty and self-exigency and the ability to acknowledge failures and tolerate outside criticism. Furthermore, the true scientist always seeks the criticism of his colleagues in order to be able to check the direction and the purpose of his searches. Sometimes even his best associates will disagree with him and will thus help him to find the scientific truth.

As to the morality of the scientist, I find it difficult to tolerate the fact that some of our scientific managers (who hold this position by virtue of their social status) benefit from other people's work and develop conflict situations involving those who dare to argue with them. These are people who have accidentally assumed positions in the difficult and responsible field of science!....

[Question] What is your view on Mayakovskiy's warning that "unless we put a humanistic muzzle on science it may bite man....?"

[Answer] Do you mean by this the moral responsibility of the scientist? Yes, in an area such as ours it is indeed very big. Ever since the nature of the gene was discovered and possibilities were developed of manipulating it the fear has developed of a misuse of so-called gene engineering. However, it is a question precisely of the deliberate focusing of scientific achievements to work against man rather than the danger which such achievements may encompass. That is why, without reducing their vigilance or prematurely setting their civic conscience to rest, scientists throughout the world are continuing their research in this area, for it is vitally important to all societies and because it will yield discoveries of great practical value to mankind!....

Progress in Molecular Biology

Sofia TRUD in Bulgarian 4 Aug 81 p 2

[Article by Tanya Kondakova]

[Text] Once, objecting to Academician Oparin's stipulation that in biological systems new biological laws which assume priority and main significance in the further development of animate beings may appear, in addition to familiar physical and chemical laws, one of his opponents exclaimed: "Poor molecule! What would it do in such a case? What laws would it obey, physical or biological?"

I reminded Academician Rumen Tsanev of this semianecdotal case and asked him, taking it as an introduction, to raise a bit of the curtain behind which hides the secretive, revolutionary and very promising science known as molecular biology. However, in the same way that his colleagues found it difficult to explain the code with which genetic information is translated from the language of nucleic acids to that of proteins, he finds it difficult to give us a popular "translation" of research and discoveries in this area in order to avoid oversimplification!....

He is assisted by his innate ability to think in both concepts and images and by his wit: "Does the very name of the science not reveal that we are dealing with the organization of life on the molecular level? The point is that we are studying not any type of molecules whatever but the complex, the gigantic molecules, which are also known as biopolymers, thanks to whose appearance matter made a quantum leap from the inanimate to the animate."

It is infinitely tempting to enter the delicate, streamlined and incredibly varied world of biopolymers through the entertaining story of the scientist, as though modeled by a wasteful master craftsman--nature; and to find out that proteins and nucleic acids have their own "alphabet," and that the unique individuality of each organism is determined also by the order in which their "letters"--their building units--are arranged. "With the DNA molecule, the material carrier of heredity," Academician Tsanev said, "nature has developed an amazing method for the coding of information, as yet unreached by human technology. For example, information on an individual is encoded in a nuclear cell invisible to the naked eye. If we were to attempt to record it in writing we would need about three million regular-sized pages!"

Molecular biology means the practice of biochemistry without a license: this is a rather popular joke among scientists in this field. Academician Tsanev added that the science was developed by physicists: what better proof of the beneficial alliance among the various fields of science! I recall the strong interest which was triggered several years ago at home and abroad by the results of his joint work with Academician Blagovest Sendov. Their successful experiment in mathematical modeling of the regulatory mechanisms of cellular multiplication earned them the Dimitrov Prize and... the original assumption that the cell contained not only genetic but other types of information as well, a program according to which a given organism will develop.

Could it be that it is precisely Bulgarian science that is about to make a substantial contribution to the unraveling of one of the great and exciting secrets of life? Its leading representative in this area does not give a hasty answer to the question (restraint is a characteristic feature of the true scientist). At the same time, however, he does not conceal that the hypothesis has been supported by a number of experimental proofs and that it is the main axis around which basic research of the collective he leads rotates....

Topic: "Scientist, Collective and Practice," at the Institute of Molecular Biology of the BAN

More experiments, vigil, tremendous patience and persistence are needed. Irina Tsaneva, a biologist, is observing biopolymers and their complexes with an electron microscope.

Actually, from the very first of the several days I spent at the institute I fell in the midst of the feverish "search for new additional proofs" which possesses every scientific worker. Such proof does not come in 1 or 2 days or a week. It requires more and more experiences, vigils, tremendous patience and persistence, for the instant of joy given by success may prove to fleeting and misleading, while untruth in science does not benefit anyone and is inadmissible. I saw this with my own eyes, through the excitement which was triggered by the experiments initiated in our country for the development of so-called hybridomes which produce specific antibodies. I saw this with the microscope. The personnel, who were watching them from morning until night, cautiously said that it was still early for the end result, which would appear only on the 24th day. I also witnessed the strict but just rebuff of an otherwise conscientious technician who had taken defective photographs of cell nuclei. No one, however, thinks of being insulted or of apologizing....

Such are the "ordinary" details which fill a day of research aimed at reaching the depth of the microworld. This is nothing new. In this case, however, it is an indication of the long road which must be covered to the point of a scientific publication which would contain original features and would represent a substantiated contribution rather than simply a skillful compilation of familiar truths.

I emphasize this, for according to data of a statistical study conducted by the BAN Scientific Information Center, the works of the personnel of the Institute of Molecular Biology are the most frequently mentioned achievements of Bulgarian science and because it is precisely here that the qualitative characteristics rather than the number of publications are the criteria in assessing the work of the individual scientist. Such work is assessed publicly. At meetings of management and scientific councils the criticism of creative scientific work has been raised to a cult. This already established style of work is known to and supported by everyone. Is it astounding, therefore, that in this institute there is no need to publish a "house" periodical as is practiced by so many other institutes, and that the collective has boldly and openly gone straight to the international "market," and let others, impartial observers, to assess our work instead of doing it ourselves "at home"...

The results are found in the external features, in the fact that the members of the collective are frequently asked to present papers at international congresses and symposiums (at the time of my visit several such requests could be read on the bulletin board in the hall). It is found, most of all, in the content of the developments themselves. For example, it is no accident that it is precisely the Bulgarian institute that was assigned to coordinate the work on the topic of "Chromatin Structure and Function" within the framework of cooperation among the academies of sciences of the socialist countries. Its laboratories were the first to undertake the clarification of the complex mechanism of the so-called replication (duplication) of the genetic apparatus of superior organisms in order to establish the means through which gene activities are controlled. As we know, this determines the functioning of the cell and, respectively, of the organism. The latest data obtained by the institued were awarded the "Professor Asen Zlatarov" prize and research in this area is continuing.

A report on the latest achievements of the collective sheds light on other unraveled puzzlements of animate matter:

Some characteristics have been discovered in the organization of the DNA of superior organisms. This is a major contribution to understanding the evolutionary mechanisms;

The factors which control the means through which the ribosoma are formed in yeasts and animal cells have been studied. This is of essential importance in the synthesis of proteins and of growth of normal and cancerous cells (Professor Asen Khadzhiolov, the head of the study group, was awarded the 1980 Dimitrov Prize);

New methods were developed for the study of nucleic acids and chromatin with a more effective and more intensive description of the molecular organization of the cell (applied in Bulgarian and foreign laboratories).

According to statistical data at the institute the average age of a scientific worker and specialist here is 39. In science this is considered young. In this case, however, it also means that there is a substantial number of young scientists. I asked one of them, Oleg Georgiev, of how the young felt. "Oh, people here are not divided into young and old," he exclaimed spontaneously. "We are considered full-fledged scientific workers. Along with the "seniors" we participate in publications and discussions. We are sent along with the others to specialize or attend symposiums. If I were asked about the conditions I would prefer to insure my growth as a specialist I would unhesitatingly name those prevailing in our institute...."

Do not think that this was a means for flattering the management. The young man expressedly cautioned me against such an interpretation. Furthermore, for some reason, throughout my stay in the institute I kept thinking of the old classical schools headed by noted scientists, about which we have read, in which the famous distance which separates the professor from his assistant is shortened by itself through frankness, humor, charm and human contacts....

Actually, a jocular inscription hangs on the door of the director's office, in English: "Take care of your boss for the next one may be worse!" This sounds quite unacademical, does it not?

Bureaucratic Difficulties

Sofia TRUD in Bulgarian 5 Aug 81 p 5

[Article by Tanya Kondakova]

[Text] You are probably familiar with the legend of the mythological ancient Greek beauty who opened a box of ills which spread throughout the world, despite Zeus' ban. They included diseases. Medicine is still helpless against some such scourges, for their nature is concealed either in still unraveled mechanisms of heredity or in the molecular mechanisms which control cellular division of superior organisms.

Once again we come to molecular biology. Apparently the hope for complete and unthreatened human health is in molecular biology. We do say that the real, rather than the imaginary, future is prepared as of today, gradually, step by step, with the laying of stable foundations on which the framework of guaranteed health is built....

As I realized after several conversations in the institute, such an understanding of the direction of the efforts here is neither sporadic nor deliberate! It is not a question of a pragmatic approach to each research topic (this would be a vulgar simplification of the very essence of science), but nor is it a question of an arrogant attitude toward the concept of "application" which is still shared by some academicians. That is why I was not surprised in the least to come across the section entitled "Applied Results" among the reports submitted by the institute. Consequently, it is a question of strategy, of policy in the work of an institute.

The first example: until recently we spoke mainly of the prospects and fantastic possibilities offered by gene engineering. Today it has assumed an emphatically practical direction in the institute's structure. Its head, Professor Kalcho Markov, showed me precisely the searches and accomplishments in this area. Their purpose? "To develop new microorganisms through the transfer of hereditary material from one microbe to another." The first project has already been completed and is ready for submission to the Institute for Infectious and Parasitical Diseases and from it to clinical practice. This is a highly productive serum produced from the toxin of the intestinal bacterium, from which antitoxin serums can be created and thus treat severe diseases in children and young animals.

Second example: with the help of an immune reaction the personnel of the same section were able to discover a disease caused by carnation seeds contaminated by a specific virus. The method for the discovery of the disease and the decontamination of the seeds was applied last year and resulted in savings of about 150,000 leva. With the cooperation of Professor Evgeni Golovinski a method was developed and applied for the determination of a mutagenic and cancerogenic effect of chemicals syntehsized in the institute. However, it could be applied by any laboratory and enterprise of the chemical industry which discards chemicals in the water and the soil unaware of their danger to man. This is a problem of vital importance work on which is being done throughout the world.

Third example: recently experiments were undertaken by specialists in the field of gene engineering on the fixation of nitrogen from the air. This is another global problem with a more distant yet strategic objective. As we know, this is done only by microbes. The first basic target of the Bulgarian experimental scientists is to isolate the genes of the microbes and to develop new soil-enriching microorganisms. The more distant and quite alluring prospect is to introduce these genes in the plants in such a way that they may begin to fix the nitrogen from the air by themselves. This seems fantastic yet it is not impossible....

Fourth example: after extensive studies and experimentation the collective of the Chemistry and Biochemistry of Antimetabolites Section, headed by Prof Evgeni Golovinski, was able to synthesize several original chemical compounds--analogs with suppressing effect on the growth of malignant cells. The antitumor effect was confirmed several years ago at the Oncology Institute. Some of the researchers were awarded the "For Contribution to Technical Progress" badge; 15 authorship certificates were issued and 8 or 9 patents were granted. However, the clinical application is still at the stage of expectation and wishes. Scientific Associate Sotir Zakhariev, who defended his candidate dissertation on the same topic, supported with figures and facts his views on the reasons for the delay. Briefly stated, according to the international instruction on such tests, the stumbling block was that the toxicological studies had to be made with big animals, dogs in this case. The dogs had to be of a special breed. However, to this day the necessary number of such dogs has not been procured. Because of its low capacity, the base at Aldomirovtsi Village was unable to procure such animals and, for the same reason, the NIKhFI [Scientific Research Chemical-Pharmaceutical Institute] could not carry out the experiment despite its commitment. It is true that the project investor, the Farmakhim DSO [State Economic Trust] had decided to build a breeding center. However, "can he imagine how long this will take?" S. Zakhariev asked rhetorically. The result is a magic circle or the not entirely expedient alternative of conducting the tests abroad....

I discussed the matter with the director, Academician R. Tsanev. Quite readily he took up the subject of the "sluggish motion of the bureaucratic machinery" and of "outside obstructions." Once again, for the umpteenth time, he emphasized the need for the Bulgarian Academy of Sciences to have its own import and supply center. He cited other examples of postponed or "blocked" utilization of individual achievements, again for the same reasons. He also discussed a very important and obviously quite thoroughly considered project related to the manufacturing of antibodies in cell cultures, which would attack virul infections and some forms of cancer. "We have all the necessary forces and conditions" for the production of interferon, the name of the pharmaceutical which was recently synthesized, "if the project is financed."...

In the several meetings we had, I rarely saw Academician Rumen Tsanev relaxed behind his desk. I followed him in his constant visits from one laboratory to another, checking on the course of one experiment or another and, frequently, watching the experiment himself, listening to assessments and suggestions and giving advice or instructions. I had the feeling that he knew what was happening at every single minute in the test tubes, the nutritive media, and the other research facilities. If he was not in his office (which was far smaller and simpler than that of a director in an economic enterprise, for example), he was with one or another associate, discussing a specific, a very specific scientific problem. We were able to talk only intermittently. However, he was able to fill these short and scattered moments with maximum information and meaning. I saw him smiling, annoyed, concentrated, excited or angry. I never saw him totally pleased!

It became clear to me why he had found the best possible description of the scientist in Goete's Faustus....

Until recently we spoke mainly of prospects and possibilities of gene engineering. Today the Bulgarian scientists have scored achievements. The photograph shows Biologist Zoya Katurova and Chemist Emil Nikolov at the Polymer Physics Laboratory.

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CONDITIONS FOR INCREASED USE OF PLASTICS IN MECHANICAL ENGINEERING DESCRIBED

Prague STROJIRENSTVI in Czech No 4, Apr 81 pp 224-229

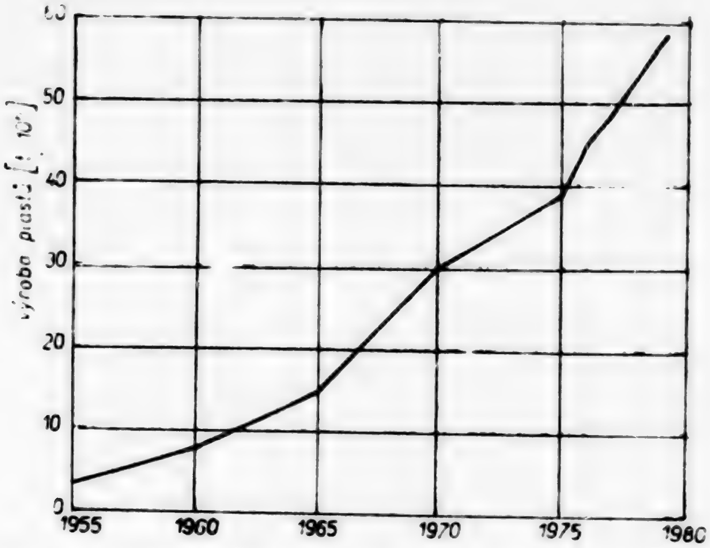
[Article by Eng V. Landa, CSc, State Research Institute of Materials, Prague: "Increasing the Use of Plastics in Czechoslovak Mechanical Engineering"]

[Text] The author presents important information on the working and use of plastics in Czechoslovakia's mechanical industry and gives a critical evaluation of the disproportion which has arisen between an increased output of plastics at the end of the last five-year plan and limited plastics-working capacities in the mechanical industry as a whole. The analysis shows that important shortcomings which are emerging have led to the current contradiction between support for plastics production and the use of plastics in the mechanical industry.

The importance of plastics and the extent of their use in all sectors of the national economy are growing steadily. The increase in the output of plastics worldwide continues to be extremely rapid (Fig. 1), currently amounting to almost 60 million tons a year. In making a comparison with the output of metals, we must take account of the fact that volume for volume, plastics weigh a third to a fifth as much as metals.

Nor will the output of these materials decrease in the future, because practically no sector of industry can do without them. Moreover, an extremely important reason for their use under current conditions is the small energy requirement for their production compared with metals, as shown in Fig. 2.

Concerns that the output of plastics might fall as a result of exhaustion of supplies of petroleum, which to date has been the main raw material for their production, have been ill-founded, because currently only about 3 percent of the world petroleum output is used for the production of plastics. Furthermore, plastics production is not solely dependent on petroleum as a raw material: considerable quantities are produced from natural gas, coal, plant materials and the like, but thus far these sources have not been sufficiently developed to make them economically preferable.



Obr. 1. Růst světové produkce plastů za posledních 25 let

Fig. 1. World output of plastics in the last 25 years.

With the implementation of the decrees of the 14th and 15th CPCZ congresses, the plastics production situation in Czechoslovakia has improved markedly, as can be demonstrated by data on the production, import and export of plastics (Fig. 3).

The current per capita output of plastics here is about 60 kg, which puts this country in a leading position worldwide (ahead of Japan, France and the United Kingdom). The expansion of plastics production in Czechoslovakia will continue in the Seventh Five-Year Plan.

Worldwide, plastics have come to play a significant role in mechanical engineering and metalworking. The cost-effectiveness of their use is indicated by some of the technical and economic advantages they offer, such as a favorable strength-to-weight ratio, their potential for optimum design (e.g. integration of components), their long lifetimes resulting from the chemical resistance of the materials used, their improved use properties under more demanding operating conditions, the increases in labor productivity resulting from the use of mechanized and automated plastics-working procedures and the like.

For example, the labor input required for 1 ton of plastic machine parts is about 64 percent less than that for metal parts, while the production cost is 43 percent less. The weight of the product is a quarter that of steel items and a fifth that of nonferrous metals. Production of parts using plastic instead of metal yields a saving of about 85 percent on electrical energy.

Key:

POM--polyoxymethylene

mPPO--modified polyphenylene oxide

PA 6--polyamide 6

PA 66--polyamide 66

UP--unsaturated polyesters

PC--polycarbonate

PMMA--polymethyl methacrylate

PP--polypropylene

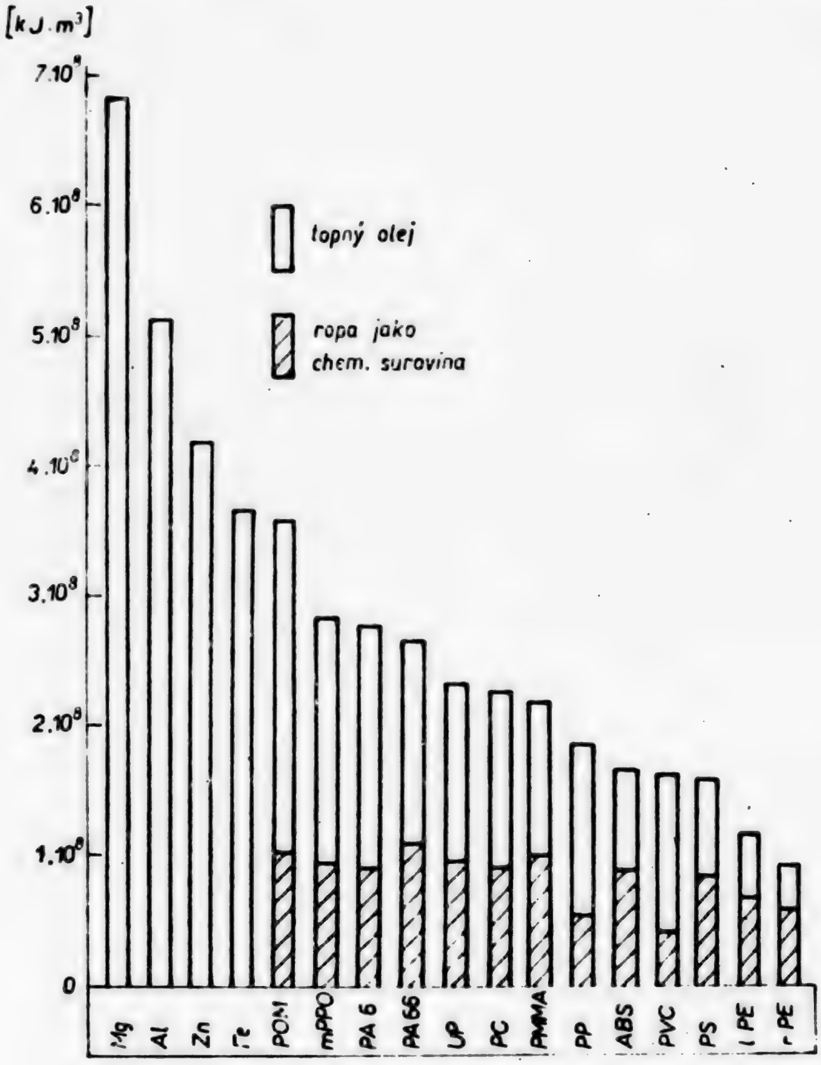
ABS--acrylonitrile-butadiene-styrene resin

PVC--polyvinyl chloride

PS--polystyrene

lPE--linear polyethylene

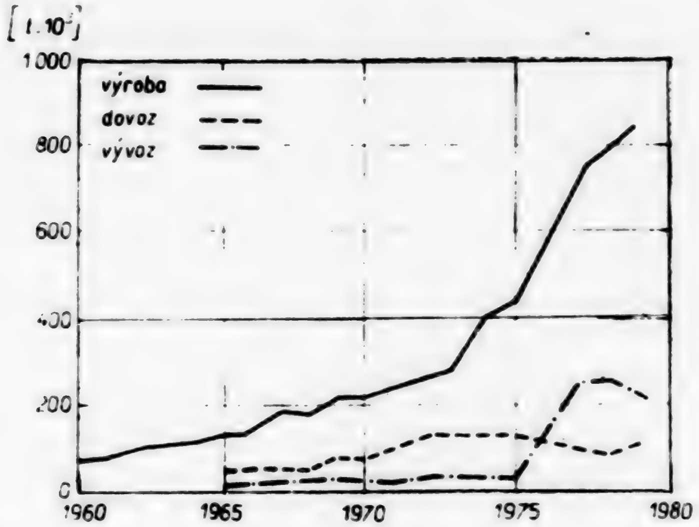
rPE--branched polyethylene



Obr. 2. Spotřeba energie na výrobu 1 m³ uvedených materiálů (u plastů včetně spotřeby ropy jako suroviny)

POM — polyoxymetylén
m PPO — modifikovaný polyfenylénoxid
PA 6 — polyamid 6
PA 66 — polyamid 66
UP — nenasycené polyestery
PC — polykarbonát

Fig. 2. Consumption of energy in the production of 1 m^3 of various materials (including petroleum used as raw material in the case of plastics).



Obr. 3. Trend výroby, dovozu a vývozu plastů v ČSSR za období 20 let

Fig. 3. Production, import and export of plastics in Czechoslovakia during the last 20 years.

Obviously these benefits are of great importance for the Czechoslovak mechanical industry, which has extensive possibilities for the application of plastics in its key product selection. Recent research indicates that the mechanical engineering divisions of production organizations in FMHTS [Federal Ministry of Metallurgy and Heavy Engineering], FMVS [Federal Ministry of General Engineering] and FMEP [Federal Ministry of the Electrotechnical Industry] are consuming about 160,000 tons of plastics a year. In general their use is centered on the following production areas:

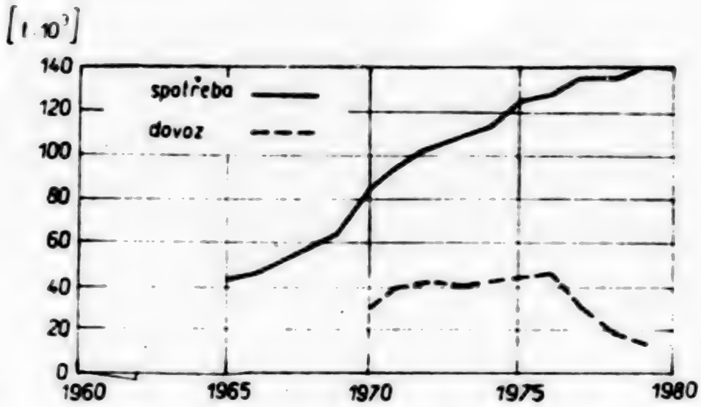
simple machine products	28.9 percent
high-voltage electrical engineering	31.2 percent
formed machine parts	9.8 percent
highway vehicles	6.7 percent
low-voltage electrical engineering	3.3 percent
chemical and foodstuff machines	1.4 percent
measuring devices and office machines	0.6 percent
consumer machines	9.4 percent
other	7.5 percent

Consumption by the mechanical sector accounts for less than 20 percent of the total quantity of plastics and plastic semifinished products available in the national economy. This finding is in sharp contrast to trends in the industrially advanced countries, where these industries account for about 35 percent of plastics consumption, especially if we bear in mind that since 1970, while the output of domestically-producted plastics has increased, the percentage of them used by our mechanical industry has been dropping (Figs. 4 and 5). Accordingly it is desirable to analyze the reasons for this state of affairs in relation to the demanding tasks facing our mechanical industry in the next five-year plan, and to make a systematic effort to rectify the situation both in the mechanical engineering ministries and elsewhere. The low level of utilization of plastics is causing considerable national economic losses, particularly in view of the fact that an analysis of selected mechanical applications in Czechoslovakia indicates that for each ton of formed products made of plastics there would be a savings of:

--Kcs 50,000 of production costs,

--1,000 Nh of labor inputs,

--3,000 to 4,000 kWh of energy.

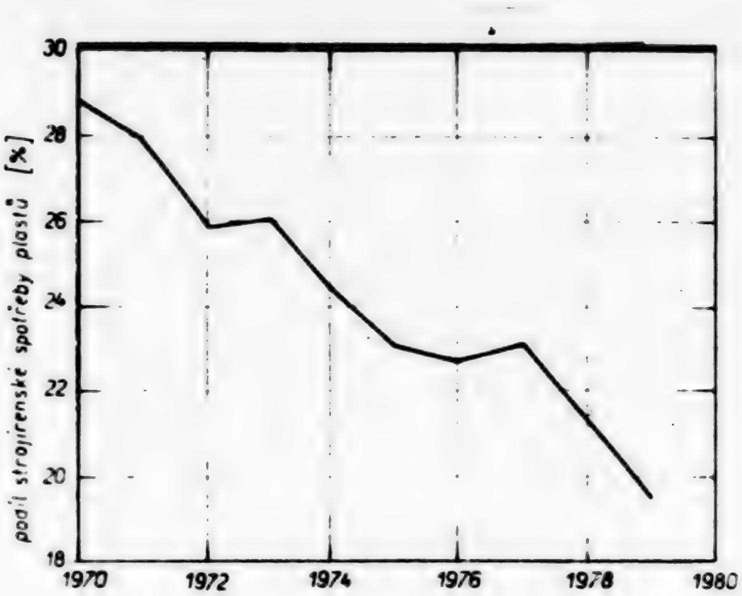


Obr. 4. Trend spotřeby a dovozu plastů v čs. strojírenství (FMHTS, FMVS, FMEP)

Fig. 4. Consumption and import of plastics by the Czechoslovak mechanical industry (FMHTS, FMVS, FMEP).

By failing to appreciate fully the technical and economic advantages of using plastics, we bring about an undesirable increase in the consumption of metals (especially nonferrous metals) in the mechanical industry, as well as uneconomical export of plastics or their primary components for processing.

When we consider the ratio of plastics output to steel output, we find that in 1977, for example, the figure was 4 percent in Czechoslovakia, 17 percent in West Germany and 12.5 percent in France. These examples are indicative of the unfavorable trend in plastics production and utilization. We must consider that the main reasons for this situation are the long-standing basic conception of our national economy based on a high steel output, an inadequate selection of plastics, especially so-called "structural" plastics, the quality of plastics-working machinery, the extent of plastics-working capacities, capabilities for efficient production of molds, our ability to apply modern scientific findings, and the quality of our technical personnel.



Obr. 5. Podíl strojírenské spotřeby plastů na celkové spotřebě plastů v ČSSR

Fig. 5. Percentage of all plastics produced in Czechoslovakia consumed by the mechanical industry.

The purpose of our sketch of the current state of affairs in these areas is to identify problems whose solution could open the way to increased use of plastics.

As regards the selection of plastics which are suitable for mechanical engineering, we may state that as a result of intensive development of new production capacities during the Fifth and Sixth Five-Year Plans, the Czechoslovak chemical industry does provide the main varieties of mass-produced plastics, i.e. polyolefins, polyvinyl chlorides, styrene polymers, polyamides, polymethyl methacrylates, cellulose derivatives, epoxy, polyester and phenolic casting resins, and press-molding materials based on them, although it by no means offers such a selection of these materials for mechanical applications as is currently available from foreign producers. Moreover, a number of plastics currently described as "engineering" types, without which applications in many mechanical industries are unthinkable, are conspicuously lacking. In particular these include polycarbonates, linear polyesters, polyurethanes, fluoride polymers, polyacetals, polysulfines, polyphenylene oxides, polyphenylene sulfides, other types of polyamides, diallyl phthalate and alkyd press-molding materials, thermosetting resins for injection molding, special polyester resins and the like. Obviously there is an extensive variety of modifications of these types abroad, which is opening new possibilities for the use of plastics in a variety of other areas.

This state of affairs is the reason why some applications are impossible because of a lack of materials, or simply because they would require importation of plastics from nonsocialist countries. In this connection we should point out that with the possible exception of fluorine polymers and polyurethanes, thus far there has been only a small degree of commercial exchange of materials among the countries involved in socialist economic integration. Excessive requirements for imports of plastics also result from the low or falling quality of domestically-produced materials. Obviously special types of polymers such as those with high chemical and heat resistance will continue to have to be imported, but our mechanical industries have the potential for using domestically-produced modified materials which would be producible in recently-constructed chemical industry facilities. These include, for example, various filled and reinforced thermoplastics, e.g. polyolefins, polyamides and possibly ABS resins, which would go a long way toward increasing the percentage of plastics used in the automotive industry or the chemical machinery industry, to give two examples. In this connection we can only recommend that our chemical industry take a greater interest in the needs of the mechanical industry and that it show greater flexibility in deciding on production directions which are important for the mechanical industry. This would include, for example, beginning the production of modified polyphenylene oxide and thermoplastic polymers which have been developed in this country. In both cases it would be possible to limit imports not only of these materials, but also of certain other types of structural plastics, from nonsocialist countries.

Inseparable components of the process of increasing the percentage of plastics used by the mechanical industry include research, particularly applications research, and a method of efficiently translating its findings into practice. A number of research institutes and organizations in the mechanical engineering field, general directorates of plastics producers, advanced schools and other institutions in Czechoslovakia have joined together for research in this field.

In recent years special attention has been devoted to new types of Czechoslovak plastics produced by Chemopetrol k.o. For example, data on the physical and mechanical and mechanical properties of Czechoslovak polyolefins and on the changes produced in them by temperature, stress, environment and time have been obtained, proposals for new standards or revisions of existing standards have been developed for the purpose of upgrading specifications and completing lists of materials, methods of evaluating the quality of thermoplastics for injection molding subject to state testing have been worked out, and design guidelines for injection-molding varieties of linear polyethylenes, polypropylenes, PVC's, ABS terpolymers, polyamides and tough polystyrenes have been drafted. To assist the industry, a number of specialized technical and economic papers on plastics and catalogs of components have been produced in order to facilitate decisions on materials and the use of molds and increase the possibilities for cooperation between enterprises.

In spite of this considerable amount of work, in the near future it will not be possible to provide enough of the data required by designers. Designing and dimensioning plastics products currently requires knowledge of a variety of data on the behavior of the materials in complex stress states and under the influence of other factors which cannot be evaluated by simple tests. The question of correlating the results obtained from a test body with the characteristics of a product is still a difficult one, as is the question of what effect the type of working used has on the properties of a piece, semifinished product or finished item. In addition, the development of testing methods for determining engineering properties is far from simple, in view of the current extensive selection of plastics of various consistencies which have been developed for single purposes and are worked using a number of special processes for an extremely varied range of applications. Nor may we overlook the question of the lifetime of a material or product, which makes testing more complicated by necessitating the preparation of toilsome, demanding, expensive programs. In the case of finished products, essential requirements include the introduction and especailly the standardization of test methods, designation of a definitive selection of plastics, and provision of the necessary testing equipment. The complexity of this problem is fully reflected in the setting of standards, where most test methods are used to provide materials specifications for sales purposes and do not yield the data required for design.

Accordingly, the most efficient way of resolving the shortage of design data at present is the creation of materials information systems which accumulate information and classify it in terms of various design considerations. To this end, for example, SVUM [State Research Institute of Materials] has developed a first, simple system of materials information cards on plastics, the INFORM SVUM system, which currently is being used by more than 750 plants and institutes. In keeping with the worldwide tendency in industrially developed countries, in recent years we have been developing a new, more extensive computer-based information system at a higher level of quality, which is expected to begin test operation in 1980. This system is compatible with the System of Standardized Data on Properties (SSSD) which has been developed in CEMA.

But progress in introducing plastics to the mechanical industry is not only dependent on a knowledge of materials properties and the existence of design data; the questions of developing and equipping the industrial base for the working of plastics are especially pressing at present, as are questions of producing molds for plastic forming, which have a critical effect production economy and product quality. The situation is equally complex in these areas.

The main process equipment for the production of plastic parts is machines and molds, which differ with the process used and the nature of the product.

The most widely used production technology in this country is injection molding, which is used with more than 35 percent of all plastics. This is followed by press molding, accounting for about 10 percent, laminate production, at about 5 percent, blow molding at 2.5 percent and vacuum forming at 1.6 percent. No increases in the percentages accounted for by these technologies are planned for the Seventh or Eighth Five-Year Plans, because of a shortage of domestically produced equipment and toolmaking capacities, a dependence on importation of equipment (vacuum forming), a shortage of high-quality domestically-produced thermosetting plastics for injection molding and the like.

With an average 15-year lifetime for a plastics forming machine, 6 to 7 machines a year must be replaced; in injection technology alone, where during the Seventh Five-Year Plan an increase in the number of machines from 2,027 to 2,482 is planned, this would require 1,125 new injection machines, while in casting technology, with a planned increase from 1,678 to 1,814 machines, it would amount to 690 molding presses. This does not provide for resolution of the situation regarding plastics-working machinery. For example, Prago-Union (Plastimat and LNH [Press Plants for New Materials]), the largest plastics working concern, about half of whose products, or 31,000 tons, are cooperative technical items, has injection molding machines whose average age is greater than the length of the modernization cycle, and only 80 percent of the machines are suitable for automation.

The selection of plastics-forming machines currently includes a large number of European and transatlantic state-of-the-art and less advanced models. Accordingly, given the larger quantities of plastics to be worked in the future, we may expect more difficulty in this area as a result of both differences in models and a shortage of foreign exchange for updating the inventory of machines from the nonsocialist countries. This fact further intensifies the need to produce our own machinery or to focus on imports from socialist countries. The situation with regard to the production of plastics-forming machinery and the process of renewing the machine inventory in Czechoslovakia can be judged from the following survey:

--Injection molding machines. The traditional producer, TOS [Machine Tool Factories] Rakovnik, has developed and put into production the CS model series with injection volumes ranging from 30 to 7,000 cm^3, while further efforts to develop machines with modern control and regulating technologies has been suspended; during the Sixth and Seventh Five-Year Plans production has gradually been limited to Vihorlat Snina National Enterprise, which is building a new production facility for the modern CS series with the aim of gradually expanding annual output. However, this enterprise still has insignificant design and development capacities. The development of injection machines for termosetting plastics will also continue at Vihorlat Snina during the Seventh Five-Year Plan. From the CEMA countries, injection machinery from East Germany (Kuasy VEB Trusioma series) and Poland (the Monomat series from Polimex) is available to us.

--Presses for direct press molding and transfer molding of thermosetting plastics. Production by the TOS national enterprise has been suspended, and they are imported from Zywiecka fabryka maszyn [Zywiec Machine Works] in Poland (PHM series).

--Extrusion machinery and blow molding equipment. This is produced with extruder diameters from 30 to 90 mm by Chodos Chodov National Enterprise, which also produces automatic blow molding machines for small hollow bodies.

--Vacuum forming machinery. This machinery is not produced in Czechoslovakia: machines for forming slabs and sheets must be imported from Hungary (Techimpex, VP series).

--Other production technologies (winding and injection molding of glass-polyester laminates, rotary casting, welding, foaming, application of coatings and the like). These account for a smaller volume and most equipment is imported or produced with in-house resources.

The situation as regrads process accessories for the main plastics-forming machines such as tempering equipment, driers, heated hoppers, mills for crushing waste, equipment for machining injected and press-molded pieces, materials conveyors, mixing boxes and equipment for measuring process parameters and the like is also unsatisfactory. The individual enterprises design and produce these accessories with in-house resources, mostly only for their own use, or resort to import.

Another equally important condition for expansion of the use of plastics is the production of molds. Mold production is a constant, long-standing problem for the entire mechanical sector and is delaying the more extensive use of plastics in it. Currently the time elapsing between the design and putting into production of a plastic structural element or part averages 2 to 3 years. One exception is the molds which mechanical engineering enterprises design and produce themselves. The most pressing problem is the production of molds for small and medium-sized series, which are essentially machine industry products. Of the various technologies, injection molds account for the largest volume, followed by press molds and blow molds. Other technologies do not make as great demands for the production of tools, and toolmaking work can be replaced by other production methods, especially forming. While the machinery for individual forming technologies is to a certain extent universal and represents an investment of long-term significance, molds are limited by the specific requirements of the application in question (material, shape, dimensions, tolerances, size of series and the like) and are critical in determining whether technically and economically satisfactory results, i.e. products of the required quality, are obtained in plastics production.

It turns out that about 70 percent of all plastic molds resemble each other in some respect. Accordingly, the idea of using a uniform set of symbols to standardize mold components is nothing new: in the United States, for example, the basic standardized system of molds was created before World War II. Our main plastics-working enterprises are also giving considerable attention to the question: the Plastimat enterprise has developed the RAFO system of modular frames for injection molds, which is being used in about 50 percent (prospectively 80 percent) of the molds produced and accounts for an average of 15 percent of the labor inputs in mold production. A draft design for standardized frames for molds for thermosetting plastics has been developed by the LNH national enterprise in Vrbno near Praded. Unfortunately the production of these universal, standardized parts for mold production is limited to the toolshops of specialized press molding plnats and is not being used extensively so that it can have a nationwide effect.

Functionally the most important part of a mold is the forming cavity (or forming section), which currently is produced in most cases by the classical method, namely machining.

When using new methods of producing the forming parts of molds it is necessary to solve a group of questions expressed by the formula economy-lifetime-precision. Production methods in current use in Czechoslovakia include contour grinding, electroerosion machining, electrochemical machining, galvanoplastic mold production, pressure casting from nonferrous metals (pressing into molten metal), production of shell molds from easily fusible metals by injection (e.g. the MCP system), injection of shell molds made of nonferrous and ferrous alloys (e.g. the TAFA system), pressing into steel and extrusion through a die, casting of nonferrous metals and steel in sand, ceramic or plaster molds, and casting of filled resins, silicone rubbers or combination materials.

These methods have their advantages and disadvantages as regards precision, suitability for large and small injection molding series, and cost as compared with production by machining.

A major shortcoming is the fact that these methods have been introduced in various enterprises solely for in-house use and without coordination, and that there is no specialized tool works to produce plastics molds which would be able to master these technologies and develop them to national significance.

In addition to plastics production, materials research and the condition of the plastics working base, another important factor in the introduction of plastics is the matter of technical development at the enterprise and plant levels. The concept of assigning designs which have been suitably checked and tested in prototype molds to specialized producers presupposes the existence of research, applications and testing centers for plastics in each VHJ. But it has not always been possible to establish such centers and frequently not enough attention has been given to providing those which do exist with materials and manpower. The inadequate activity of these centers is one of the main reasons for the slow introduction of plastics into the mechanical industry to date. We should add, referring specifically to large specialized plastics-working plants, that a number of mechanical engineering enterprises have balked at the production realization stage of specific applications, either because of inadequate capacities or for other reasons.

The continual expansion of scientific and technical knowledge in the polymer field makes it necessary to train specialized technical personnel. The system now in existence, implemented either by social or other institutions through lectures or classes, or by advanced schools through postgraduate courses or research seminars with a limited numbers of participants, is not commensurate with the importance of these data and the needs of mechanical engineering plants. There is a universally-felt shortage of systematic, specialized education in the broader sense, both for lower-level technical personnel and for designers and process engineers with advanced education, which might, as in the case of metallurgists, lead to skillful use of plastics in the plants and a decrease in the risk of failure which currently occasions such mistrust of these materials and is hindering their utilization. Accordingly, if we are to try to comply with the conclusions of the 18th session of the CPCZ Central Committee and the 16th CPCZ congress regarding efficient production in the mechanical industry through increased use of plastics, we must proceed on the basis of actual conditions as regards material resources, production capacities and the equipment base, and the quality of research, standardization, and technical personnel. In a number of cases the situation can be resolved by organizational measures and mobilization of unused potential, but a comprehensive solution is impossible without investments, including import from nonsoicalist countries.

Below we survey the critical factors involved.

In the materials area:

--an expansion of the selection to include materials developed by the Czechoslovak chemical industry which are expected to go into production in the next few years (polyolefins with mineral fillers, basic polyamides, glass-reinforced thermoplastics, modified polyphenylene oxide, polyethylene terephthalate, polyolefin-elastomer mixtures and the like);

--improvement and expansion of the selection of semifinished products (domestically-produced and imported) suitable for prototype and small-series production, with an estimated consumption of about 20,000 tons per year by the mechanical industries;

--acquisition of foreign exchange for essential import from CEMA and nonsocialist countries of engineering plastics whose production is not contemplated in Czechoslovakia and whose replacement by domestically-produced materials is impossible because of their properties (high temperature stability, resistance to chemicals, resistance to low temperatures and the like);

--establishment of price relations for plastics relative to conventional materials in terms of their raw materials inputs, production costs and world supplies of main raw materials.

As regards the industrial base and technologies for plastics working, they include:

--the mobilization of plastics-working enterprises' reserves, e.g. by increasing the shift work coefficient and by increased use of operation of several machines by one worker;

--more intensive, higher-quality cooperation between enterprises in all sectors (product design, mold design and production, automatation and modernization of production facilities and the like);

--modernization of the industrial base for plastics-working and a decrease in the average age of plastics-working machinery by purchase of new machinery and planned development of progressive production equipment;

--intensive development and introduction of progressive plastics-working technologies, particularly injection molding of thermosetting plastics, including development of the necessary machinery;

--the development of special design units for new products, molds and production plant facilities (including the completion of application centers in mechanical plants);

--orientation of long-term modernization efforts toward automatic control of industrial processes and modernization of technology, both by our own research and development facilities and as part of international cooperation (in CEMA), or by deliberate purchase of licenses;

--an increase in the tool works' capacity to produce plastics molds, including supplying them with the needed quantities and selection of metals;

--the development of specialized organizations for production of molds by unconventional methods.

As regards the research and development base:

--in accordance with the worldwide tendency in materials research, a balance should be struck between investment and manpower support of the research and development base for plastics applications on the one hand and materials applications approaches which were traditionally preferred in the past on the other;

--the use of properties which are important for design, dimensioning and production of plastics parts should be evaluated using new scientific findings and modern experimental and computational methods;

--efficient translation of research and development results into practice should be improved by developing materials information systems using computers with a greater ability to accumulate and report operating data on plastic components or structural elements;

--in the area of standardization, when drawing up lists of materials, stress should be laid on the chemical industry's requirements regarding materials specifications relevant to use properties, and more sectorial standardization organizations should be used to unify enterprise setting of production standards;

--applications centers in the individual VJH's should be completed in material and technical terms;

--an effective part should be taken in planning joint experimental programs within CEMA and more use should be made of the results of joint research.

In the training of personnel:

--regularly established, constantly operating organizations should be created to give regular training to technical personnel to the extent prescribed for their proficiency levels;

--the amount of education on polymer materials and their working should be increased in basic trade schools and advanced technical schools.

For the sake of our national economy the important problems described above, whose solution will foster more extensive use of plastics in the mechanical industry, must be evaluated responsibly and skillfully.

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ACADEMY SECRETARY AIRS VIEWS ON RESEARCH GOALS, APPROACHES

Budapest NEPSZABADSAG in Hungarian 16 Aug 81 p 5

[Interview with academician Lenard Pal, chief secretary of the Hungarian Academy of Sciences, by Denes Kovacs: "Science and Society." Place and date not given.]

> [Text] The changes in world economy that took place in the 1970s, not to speak of deteriorating international relations, created more difficult conditions for our country's economic and social development. The new conditions present higher requirements for our scientific research as well. Related problems and tasks were discussed with academician Lenard Pal, chief secretary of the Hungarian Academy of Sciences.

[Question] It came up frequently at the Academy's general meeting of this year how scientific research can adapt to the changed situation. What are the tasks that researchers and science management organs face?

[Answer] International and domestic social and economic movements and changes will affect our scientific activity in the 1980s even more than before. The already existing requirements for society, and those coming in the future, may be met only if scientific research also adapts to them and takes part in the creation of conditions necessary for meeting these requirements. And this means, even in the area of science, improved output and quality, more spirit of creativity and enterprise, and higher standards and culture. This development can unfold not as a result of spontaneous forces but that of careful and conscious action.

Today's politics create favorable conditions for creative initiative in all areas, including science. And the existing achievements of building society serve as an adequate basis for the next steps and for accepting and solving tolerable conflicts. There is a need for this, for this is the only way in which the favorable tendencies in the socio-economic processes can strengthen. In order for the socio-economic processes to have more effect on science, and vice-versa, we must continually modernize society's system of planning, regulation, decision making, management, training, institutions and organizations, and the sphere of interests and values that affect social action. This modernization will help not only improve the mutual effects of science and the socio-economic processes but will also help us adapt more efficiently to society's and the economy's real laws of movement.

[Question] There is a danger today that, as a result of every-day pressures, a perspective and long-range planning is pushed into the background in society and the economy, and perhaps most of all in science. In science, this may result in a neglect of basic research. How significant is basic research at present?

[Answer] In recent years' research planning and research management, research that was directly connected primarily to economic goals, and technical development were emphasized more, understandably and rightly so. This may have resulted in some scientists' belief that, on the one hand, basic research and long-range developments are less important now than before and, on the other hand, that basic research is more or less limited and pushed into the background. The task now is to adapt the types of research more to our country's resources, economic possibilities and needs. No matter how much attention is paid to the present short-range tasks, we cannot allow research that is supposed to, and can, influence the future, to lose its real significance. Our economists frequently say that even short-range decisions and measures have long-range consequences, and this statement can perhaps even be reversed: the short-range and momentary effects of long-range measures cannot be neglected either.

When, among rapid changes, we put great emphasis on the importance of various concrete and short-range research that promise direct practical results, it would be a mistake to forget that in order to carry out these tasks, we need new ideas and a background of high-quality basic research that points toward the future. The essence of basic research is to discover the unknown, to discover new phenomena and laws. It is evident that research that is directed toward the discovery and understanding of still unknown laws is different from research directed toward concrete economic goals. For discovery and the exploration of the unknown law cannot be planned ahead. Only programmable, applied and developing research can be carried out within a prescribed time period and the limits of a given fund. In spite of this, however, the selection of goals for basic research cannot be accidental.

Scientific prognoses have a great significance in determining the directions of basic research. The Hungarian Academy of Sciences has just recently finished the work of sketching up for the coming decades the expected main tendencies of scientific development. No one should think, however, that the processes that will actually take place and the processes described on the basis of our present knowledge will be identical. Our ideas about the future are tentative in all areas, including science, and the longer time span they encompass, the less reliable they are. This also makes it necessary to continually change our prognoses and ideas about the future on the basis of extensive studies of the changes that take place in the meantime.

[Question] A continually recurring problem in scientific research (including basic research) is the evaluation of results. How can one realistically determine the actual "worth" of a basic research finding?

[Answer] It is difficult and can be done only from a perspective of time. Valuable results are those which, even if they cannot affect the "weather," can affect at least the "wind" in the given area of science. However, this can be proven in many cases only on the basis of the evaluation of the international scientific public. The starting point may be the evaluation of international scientific life. If many publications are greeted with silence, that is not very good. Results of basic research are published in scientific journals which are indispensable sources of research information. It is a matter of life and death for scientists to learn about the findings of others and to publish their own findings. He who does not do this, ceases to be a scientist. It is evident that the rules of the game are different in economic and military research, but it has been proven that significant technical advancements or outstanding works yielding significant results in economy and profits (these cannot be published) are always accompanied by "purely" scientific publications on the same subjects, for no high-standard institution engaged in economic or technical research can do without a high-level scientific background.

One reason why I must emphasize this is that opinions related to scientific publications are polarized around two extreme evaluations. According to one of them, the evaluation of scientific results cannot be based at all on publications, for many sham results are published, there is a possibility for self-advertisement and, most of all, really valuable results must be put to use, not published. According to the other extreme view, only results known and accepted by the international scientific world may be considered as scientific. Both views have a rational basis, and I must only add that, according to the nature of the research (i.e., whether it is basic research or applied research with direct practical goals), one or the other approach must play a bigger (but not exclusive) role in the evaluation.

[Question] Basic research is generally not inexpensive. This is especially true in our country: our financial resources are limited, we cannot do research on everything. How can our research goals be made more rational and conscious and how can they be better determined?

[Answer] First, basic research is generally less expensive than applied and developmental research. In spite of this, more attention must be given for selection. It is imperative to support outstanding work and talent and to reject mediocrity producing sham results. How? Among other things, we must put more emphasis on competitive financial support.

The evaluation of applicants is not a small problem. Who should the judges be? For qualified people are mostly interested parties themselves--we are a small country. This problem may be alleviated by more democracy and publicity; this way, there is a possibility for an extensive comparison and a more thorough evaluation. Although I myself consider publicity a very important aspect of the evaluation, I feel nevertheless that not even publicity guarantees a completely fair selection. For we know many examples from the history of science that the majority, clinging to conventions, considered significant research concepts as senseless, and that these new and significant discoveries were made after all, was due to the will power--or self confidence, if you like--of a few determined and convinced researchers.

I think that in the area of basic research, talented and successful researchers and research collectives must, within reason, be given the opportunity to determine their own research objectives. It is the task of research management to evaluate, with the help of scientific public opinion, whether the necessary and appropriate conditions for continued "free opportunity" still exist.

I would like to mention here that in addition to basic research, a significant economy-oriented research is going on at the Academy. The real value of this research is determined not by the number of scientific publications but by economic results that were achieved. We must also see, however, that economic profit is the result of the mutual effects of many factors that can be controlled (and probably of many others which are hard to control). For this reason, economically oriented research can be evaluated only on the basis of a complex analysis of related economic activities.

[Question] Under the present circumstances, it is especially timely to re-evaluate and, if necessary, modify the long-range national research plans accepted 10 years ago. What are the main experiences gained in the course of planning and what should be the course for the further development and modernization of planning?

[Answer] I think it is very important to overview the main directions of long-range scientific research carefully and in close harmony with long-range national economic planning. Long-range research plans were made in the early 1970s in the National Long-Range Scientific Research Plan, and played a significant role in the better planning of our research; they were very helpful in bringing scientific research closer to social, economic and cultural goals. Later, however, some of the main objectives became rigid, and planning was slow in reacting to the emerging new problems. The selection of new tasks was slow and there was hardly a single instance where obsolete or less up-to-date tasks were discontinued. For this reason, our past experience must be carefully weighed, and the long-range scientific research plan must be updated. We are striving for really making this plan a continually updated system of research trends that are most important from the aspect of the society's long-range development, in a way to make it serve the solution of basic problems arising from the internal development of science on the one hand, and to make it help giving a scientific foundation for the long-range social and economic plans on the other hand. From this aspect, the new (or modified) plan may actually become an extensive conception of research policy which will include the main trends which will include, on the one hand, the foundation for economically oriented middle-range research programs and, on the other hand, the intensive domestic development of the sciences and the most important research objectives that will open up new "fields of action."

I mention it as an example that biology must be especially emphasized in working out the long-range scientific research plan, for biology, connected with other fields of science (physics, chemistry, electronics etc.), will no doubt become one of the next century's most important sciences. Namely, the development of biology makes it possible for us to influence the living world and to change the living conditions. Under our domestic conditions, the application of biotechnical methods has a great significance, for we must strive more and more for using our bio-genetic and biotechnical resources in the increase of our crop and animal production and, most of all, in the increase of efficiency. The intensive development of the biological sciences also serves our long-range economic goals. We must emphasize, however, that the biological sciences cannot do without research in physics, chemistry, mathematics, computer technology, electronics etc., and thus there is a need for working out a complex development program.

[Question] The development of scientific research is closely and mutually connected with innovative activity. How do you actually define innovation? How can we make progress in this vital area?

[Answer] In a more limited sense, innovation is defined as a qualitative development of products, production and technology, resulting in innovations that yield economic profit. This qualitative development takes place simultaneously in research, development, production and consumption and thus innovation emerges as a binding process which mediates between mutual effects; the effects of this process can be felt in all links of the research-development-production-marketing chain.

However, innovation actually includes not only economically oriented technical innovation but also social innovation in a broader sense. The level of social innovative capacity has a great effect on the success of economically oriented innovations.

The efficient satisfaction of social needs is the driving force of innovation. But the producing or marketing organization will have "its own interest" in innovation only if its economic stability is endangered more by a lag behind the leaders than by the risks connected with the implementation of innovations. Thus the element in which this process takes place has a determining role in making the innovative process easier or more difficult. And since innovation may become the source of conflicts, the change of structure will slow down and the obsolete (inefficient) activity will be stabilized if society has little capacity for tolerating conflicts or if the producing-marketing organization has more interest in eliminating the conflicts than in implementing the innovation.

All of these phenomena call our attention to the fact that the unfolding of technical-economic development is based on many conditions which are not of technical-economic nature. We must thus pay close attention to the social and organizational factors of innovation, for this is the only way in which we can help society to use the results of scientific and technical progress, and this is the only way in which scientific and technical progress can be united with the virtues of socialism.

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CSO: 2502/92

POSSIBILITIES OF THE OPTIMIZATION OF PATTERN IMAGING FOR THE PREPARATION OF LSI MASKS

Budapest HIRADASTECHNIKA in Hungarian Vol 32 No 6, 1981 pp 205-211 manuscript received 18 Jul 80

BEKE, Istvan, graduate electrical engineer, staff scientist; and BERECZKEI, Ferenc, graduate electrical engineer, staff scientist, Research Institute for the Communications-Engineering Industry.

[Abstract] The optimization described minimizes the total time required for pattern generation and stepping for each mask layer; ensures that the imaging time of the patterns for a board is shorter in both pattern generation and stepping then the expected time between two malfunctions; minimizes board consumption; and ensures that all devices have identical loadability. In generating the pattern, the ultimate goal was to use as few exposures as possible within the shortest possible time. An analytical study was carried out to characterize groupwise pattern imaging and minimization of the tracking route length. Graph theory and a novel theory for seeking the shortest Hamiltonian path were employed. Since the path length depends on the location of the starting point, an evaluation was made on the relationships between starting-point location and path length: It was found that the starting point should be the geometric centerpoint of the imaging field. A compromise must be made between minimizing path length and generation time. Figures 3, references 3: 2 Hungarian and 1 Russian.

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CSO: 2502/94

EVALUATION OF DIGITAL PRINTED CIRCUIT BOARDS IN THE TESTOMAT-C AUTOMATIC TESTER

Budapest HIRADASTECHNIKA in Hungarian Vol 32 No 6, 1981 pp 227-231

NAGY, Sandor Zoltan, electrical engineer, and FRIGYES, Ivan, electrical engineer, BHG [Beloiannisz Communications-Engineering Factory]

[Abstract] The Testomat-C automatic tester (carrying out GO-NOGO evaluations in the off-line mode) was developed at SZTAKI [Computer-Technology and Automation Research Institute]. On the basis of a control program it determines whether the board is OK or faulty. If it is faulty, the failure is localized manually. The test programs are generated with a CDC 3300 computer; testing is controlled by a small computer; the test sequence consists of data entry, testing (establishment of the input conditions and measurement of the output parameters), and determination of the next cycle. Tests are carried out cyclically. The use of the instrument for the evaluation of NYAK printed circuit boards used in telephonic equipment was described. Logic circuits, RAM memories, visual displays, and non-TTL level digital circuits are tested. Foil breaks, soldering faults, insertion faults, component faults, and other faults are identified. Fault localization speed depends on the complexity of the circuit, the effectiveness of the test program, and the competence of the tester. The instrument is capable of being further developed to permit its use to match the requirements of specific printed circuit boards better. Figures 5, no references.

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CSO: 2502/94

UDC: 681.325.5.001.4:621.373

PATTERN GENERATOR FOR TESTING MICROPROCESSORS

Budapest MERES ES AUTOMATIKA in Hungarian Vol 29 No 7, 1981 pp 258-263
manuscript received 9 Jan 81

BARTOS, Imre, and SZAMOSKOZI, Zoltan, Research Institute of the Communications-Engineering Industry, Budapest

[Abstract] The realization of testing microprocessors (such as the Intel 8080A and the Zilog Z80, widely used in Hungary) with the aid of a pattern generator operating on the basis of the stored-pattern principle was discussed and illustrated with an example. The patterns are stored in RAM memories since in this manner loops, branchings, and concentration can be best accomplished; programs can be more easily written; and the memories can be built more cheaply than in case of shift memories. An analysis of the operation of the 8080A and Z80 microprocessors indicated that a local memory made up of individually addressable segments with RAM circuits meets all requirements. The read cycle time of the RAM circuits determines the speed of the pattern generator. Output multiplexing permits the speed to be increased. In the actual testing, all registers of the microprocessor are filled with data, the registers are read out and checked for writeability and mutual distortion, all possible data are written into Register A, and a check is made to see whether there is a change in the contents of the other registers and Register A. Figures 4, references 17: 6 Hungarian, 1 Russian and 10 Western.

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10 Oct 1981